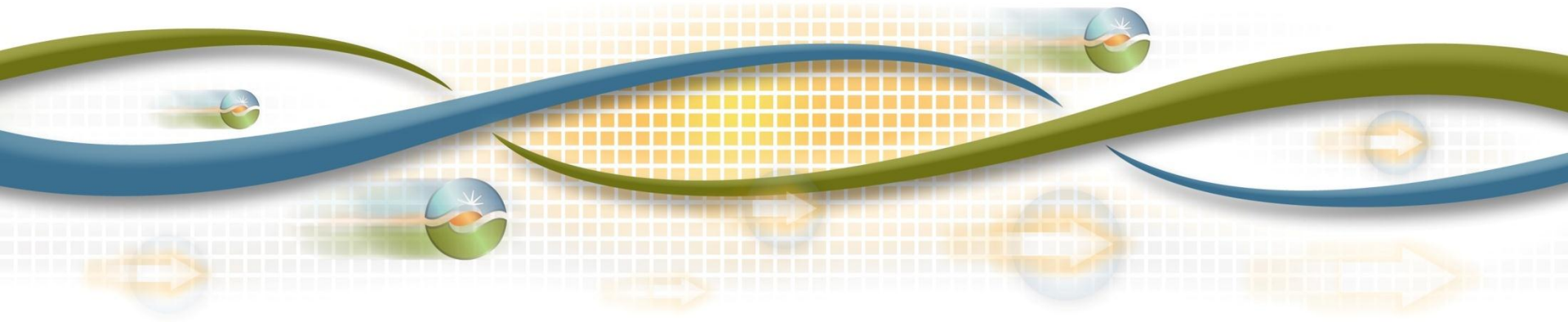




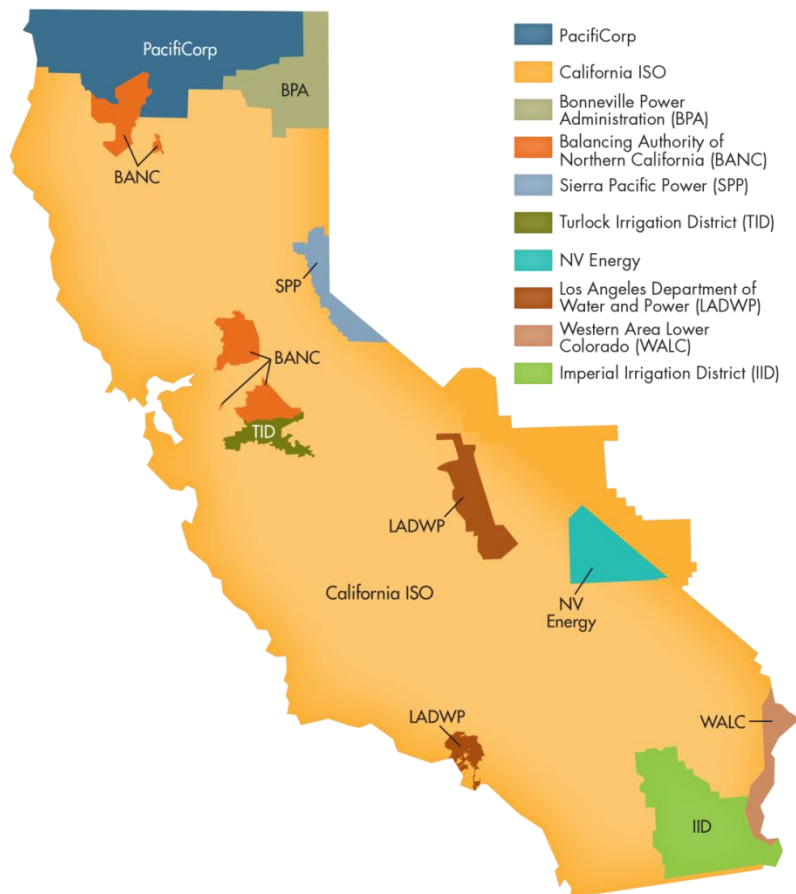
Multi-Agency Update on VGI Research

Peter Klauer, Smart Grid Solutions Manager
California ISO

California Energy Commission
December 14, 2015



California Balancing Authorities



- The California ISO manages the flow of electricity for about 80 percent of California and a small portion of Nevada
- There are certain pockets of California where local public power companies manage their own transmission systems

- **60,703** MW of power plant capacity (net dependable capacity)
 - **50,270** MW record peak demand (July 24, 2006)
 - **30 million** people served

The CAISO faces four related operational challenges

1. Downward ramping capability

Thermal resources operating to serve loads at night must be ramped down and potentially shut down to make room for a significant influx of solar energy at sun rise.

2. Minimum generation flexibility

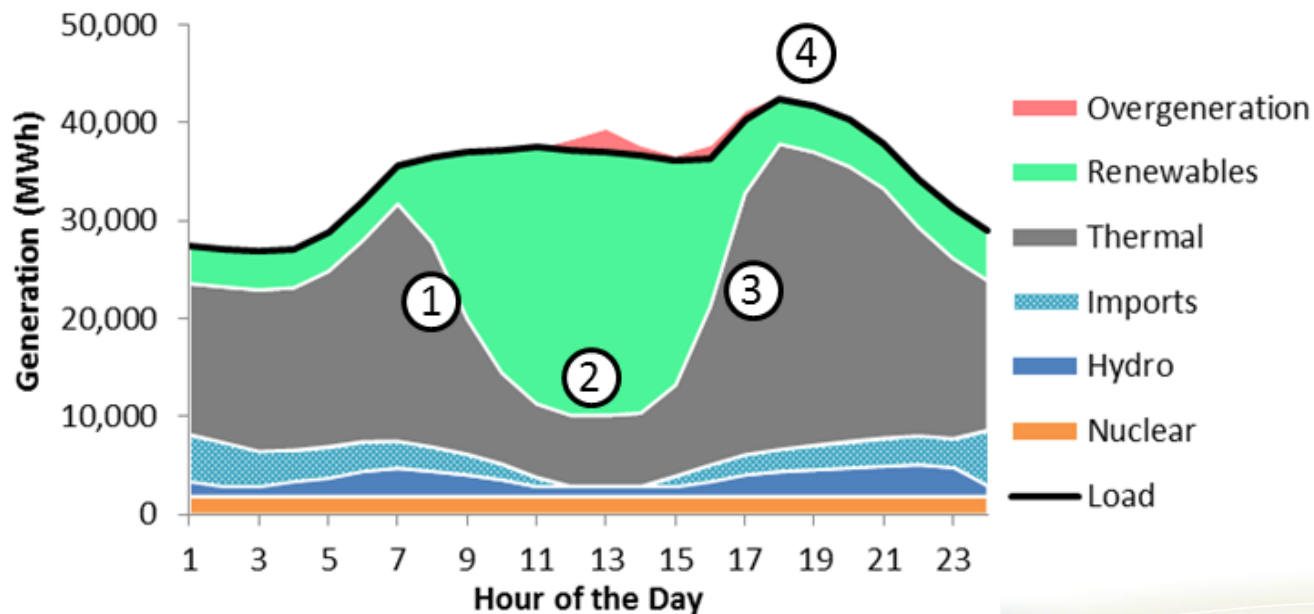
Over-generation may occur during hours with high renewable production even if thermal resources and imports are reduced to their minimum levels. A system with more flexibility to reduce thermal generation P_{min} will incur less over-generation.

3. Upward ramping capability

Thermal resources must ramp quickly from minimum levels during daytime hours and new units may be required to start to meet high net peak demand occurring shortly after sundown.

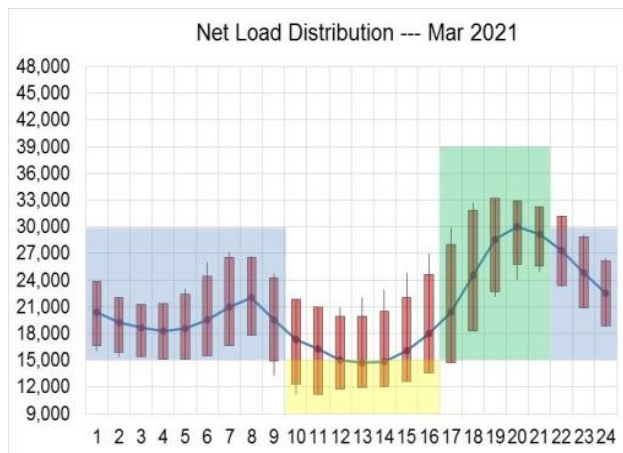
4. Peaking capability

The system will need enough resources to meet the highest net-loads with sufficient reliability

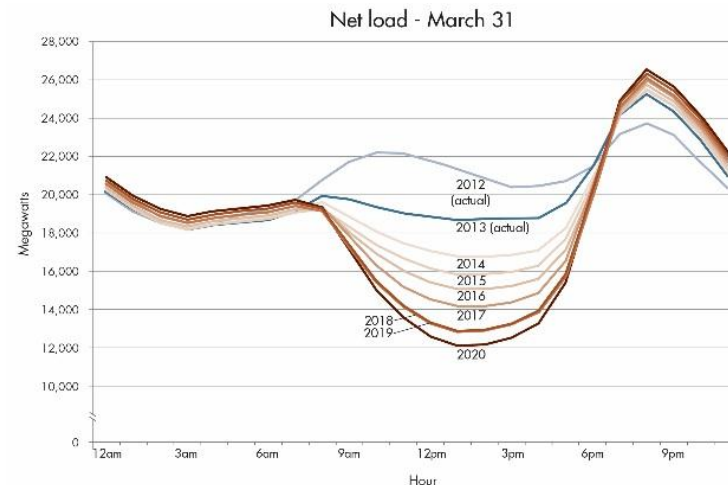


Can EV loads with the right characteristics be used to help manage California's RPS?

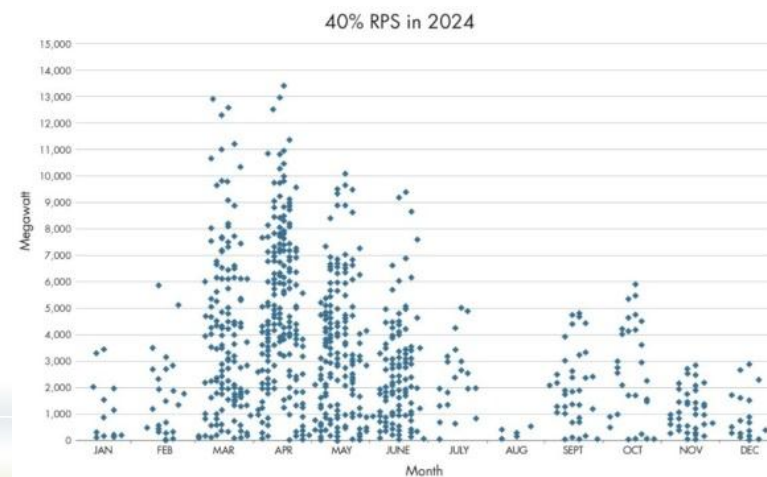
- Mitigate over supply



- Help minimize renewable curtailment



- Manage charging consistent with grid conditions



The ISO is supportive of EV related research, pilots, and demonstrations.

- SCE, PG&E, SDG&E, EVSE Developers, EV Service Providers
 - EV resources participating in ISO Wholesale Demand Response
 - EV fleet aggregations
 - Geographically disbursed DER aggregations
- Technical Advisor to CEC, DOE, University, and National Laboratory research efforts
- Clinton Global Initiative Electric School Bus
- Sonoma County Clean Vehicles for a Clean Grid Program
- Participating in EV related CPUC proceedings, workshops, and pilots
- Member of the PEV Collaborative

Demonstrating EV wholesale market participation for energy and regulation services

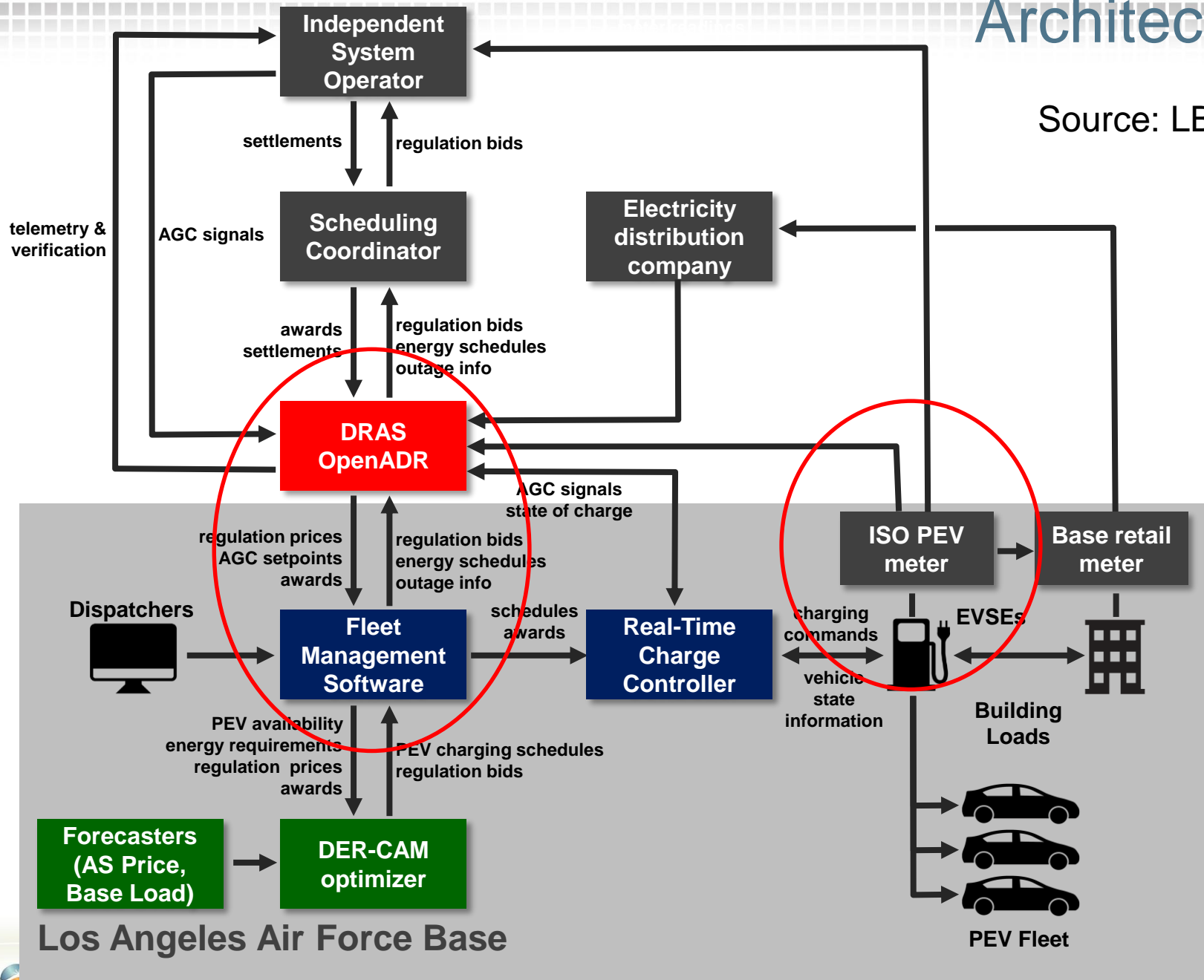
- Los Angeles Air Force Base

- Bi-directional power flow (V2G)
- 500-600 kW capacity
- V2G capable sedans, trucks, vans
- In final steps to ISO commercial operation status
- Partnership effort between DOD, SCE, CPUC, CEC, ISO, Lawrence Berkeley National Labs, Kisensum, and others.



Architecture

Source: LBNL



Three ISO Stakeholder Initiatives are underway that have direct impact on the development of EV grid resources

- Energy Storage and Distributed Energy Resources
 - http://www.caiso.com/informed/Pages/StakeholderProcesses/EnergyStorage_AggregatedDistributedEnergyResources.aspx
- Expanding Metering and Telemetry Options
 - <http://www.caiso.com/informed/Pages/StakeholderProcesses/ExpandingMetering-TelemetryOptions.aspx>
- Frequency Response
 - <http://www.caiso.com/informed/Pages/StakeholderProcesses/FrequencyResponse.aspx>

Energy Storage and Distributed Energy Resources

ESDER

Purpose:

- Enhance the ability of transmission-connected storage and distribution-connected resources to participate in the ISO market.

Scope:

- Enhancements to the non-generator resources (“NGR”) market participation model
- Enhancements to demand response performance measures and statistical sampling (“PDR” and “RDRR”)
- Clarifications to rules for non-RA multiple-use applications (provision of both retail and wholesale services by the same resource)

Expanding Metering and Telemetry Options

EMTO

Purpose:

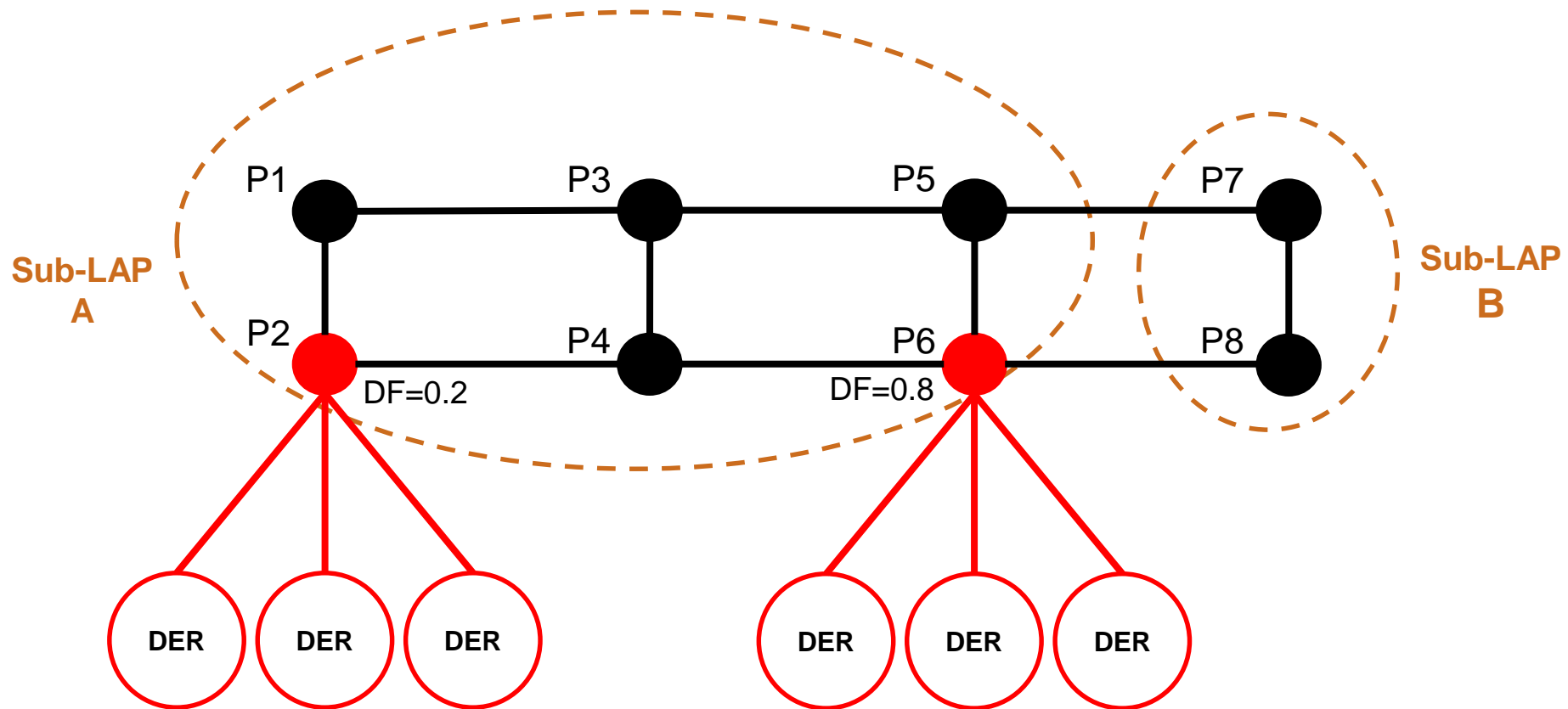
- Create a pathway for smaller resources to be bundled by utilities or third parties and collectively meet the half-megawatt minimum requirement for participating in the energy market.

Scope:

- Establishes a new market participant identity to aggregate and represent distributed energy resources
- Allows for expanded use of non-ISO meters and avoids a direct metering relationship with the ISO
- Establishes resource aggregation rules at an ISO network level

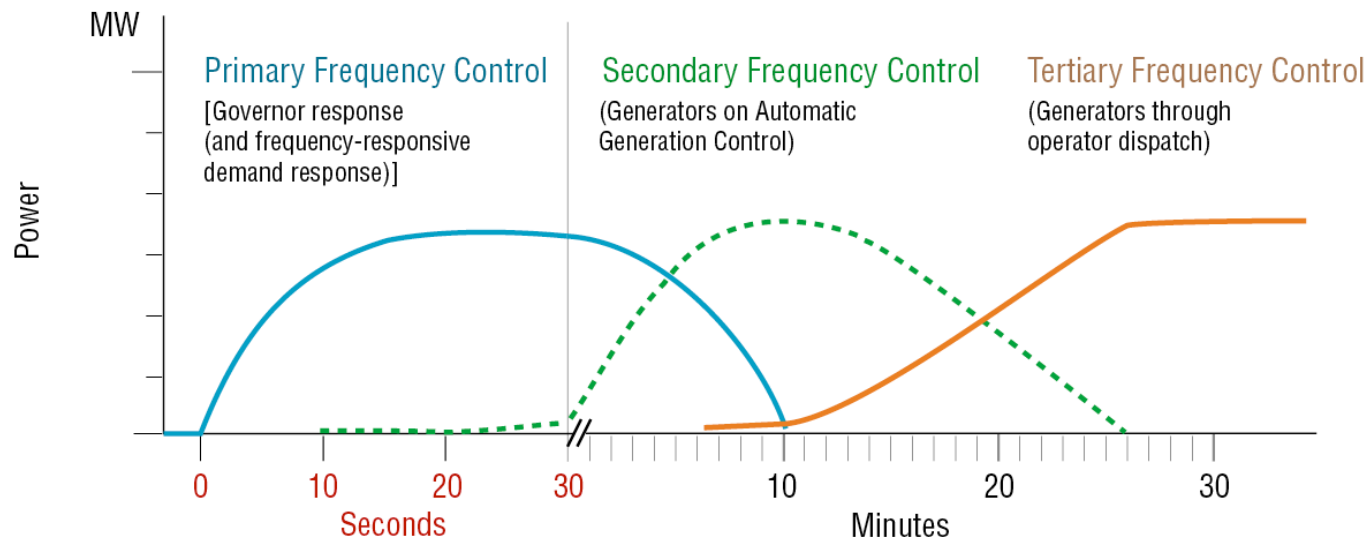
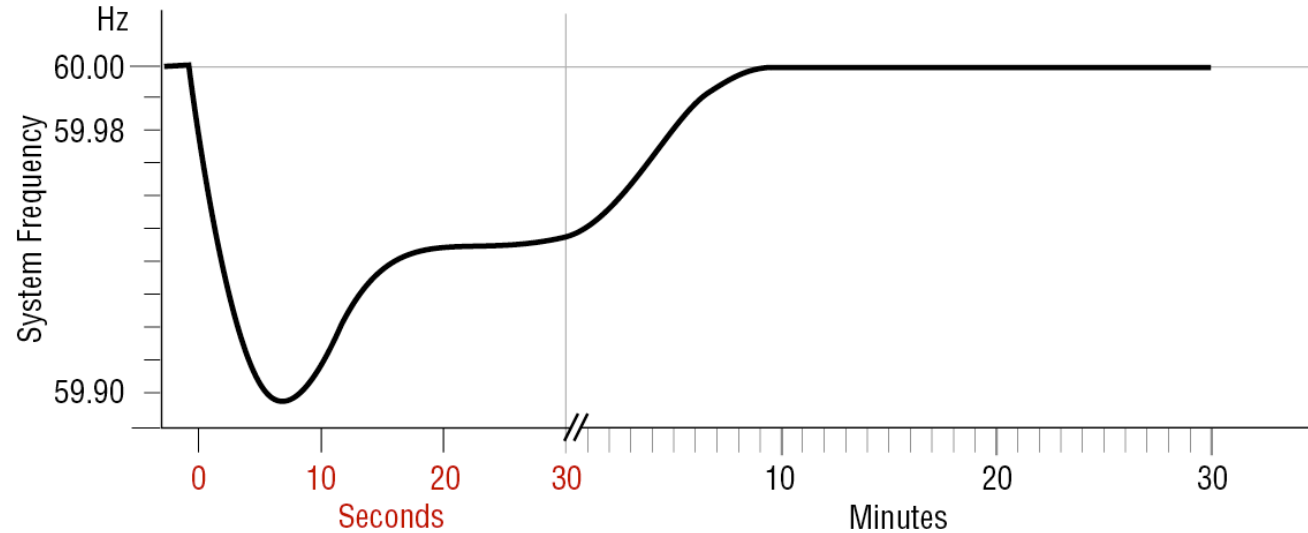
Expanding Metering and Telemetry Options - EMTO

Distributed Energy Resource Provider - DERP



Primary Frequency Response - Reliability Standard BAL-003-1

Source: NERC Frequency Response Initiative



Primary Frequency Response

PFR

Purpose:

- Develop the means to ensure acceptable dynamic response to frequency changes during the initial seconds to one minute following a large disturbance under the ISO's Frequency Response Obligation

Scope:

- Develop look ahead tools to assess the frequency response capability of the system
- Work with synchronous generators with governor control to refine and develop requirements to ensure adequate frequency response capabilities
- Evaluate the ability for non-conventional resources (asynchronous inverter based) to provide frequency response based on their individual capabilities

Next Steps

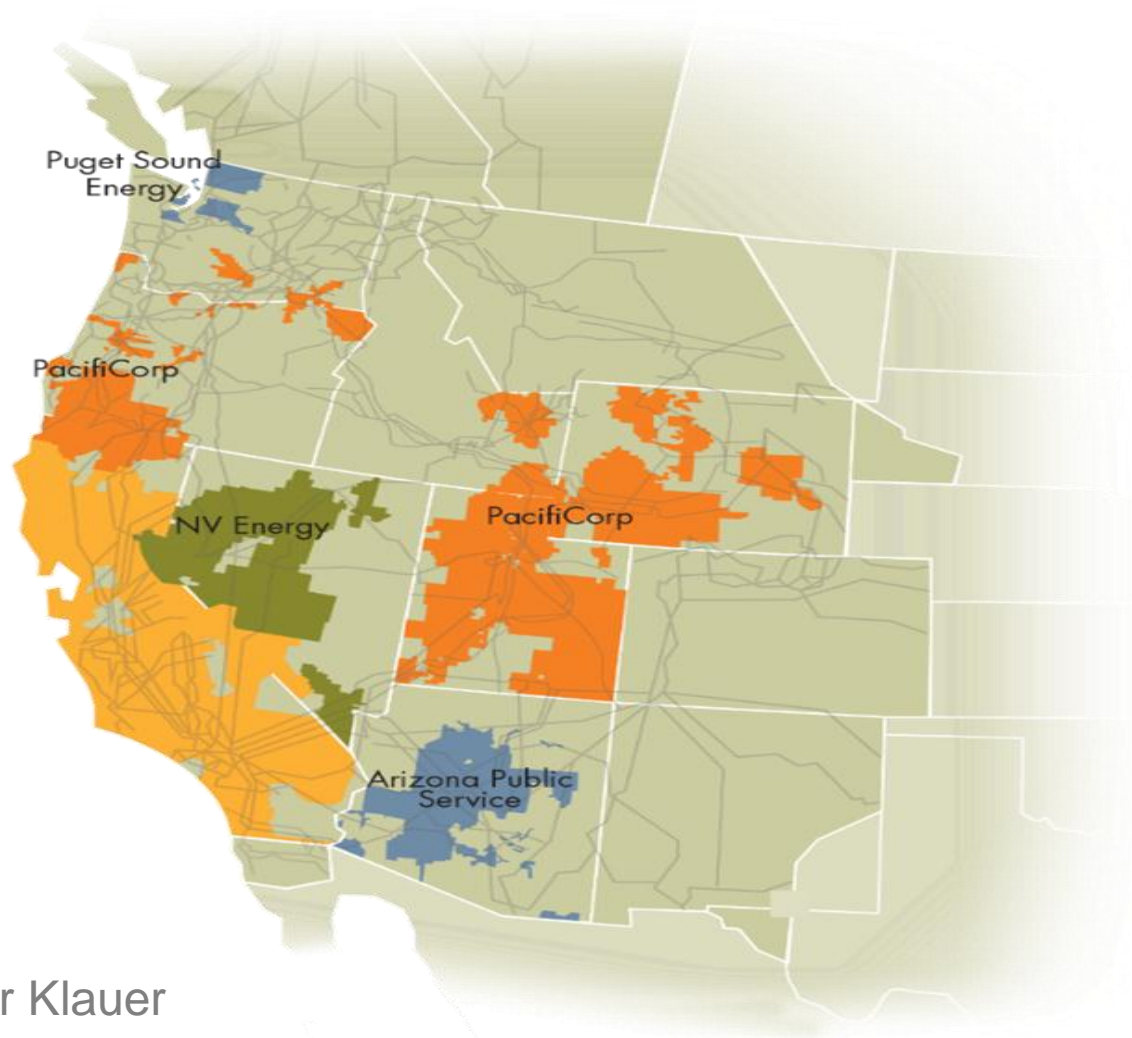
ESDER and EMT0/DERP

- CAISO is presently working with stakeholders to develop proposed tariff language for subsequent submittal to the Federal Energy Regulatory Commission.
- CAISO phase 1 implementation planned in 2016.
- Phase 2 scope and implementation planned for 2016-17

Primary Frequency Response

- Develop and implement PFR capabilities to comply with this new reliability standard by December 1, 2016
- Evaluate PFR performance through 2017 to understand the need for a frequency response market product

Questions?



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